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(56) Documents cited
GB 2241360 A GB 1573046 A EP 0391157 A2
EP 0288713 A2 EP 0259786 A1 EP 0193139 A2

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(71) Applicant
KK Systems Limited

(Incorporated in the United Kingdom)

36 Mill Hill Drive, Shoreham-by-Sea, Sussex, BN43 5TL, United Kingdom

(72) Inventor
Peter Holy

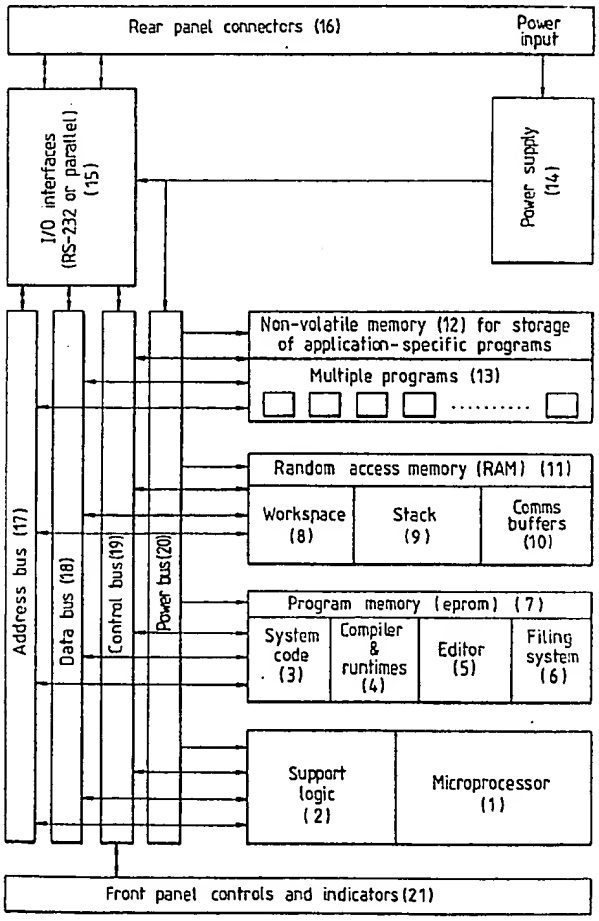
(74) Agent and/or Address for Service
M J Hoolahan
Kirklee, Church Street, West Chiltington, Pulborough, West Sussex, RH20 2JW, United Kingdom

(54) Programmable protocol converter

(57) A programmable protocol converter adapted to modify a data stream by means of an internal high level language programme which can be written by a user.

Essentially, the converter comprises a microprocessor 1, a high level language compiler 4 and one or more software storage devices 7, 11, 12, and one or more interfaces 15.

In its preferred form the PPC contains everything needed to enable a user with limited expertise to write a data conversion programme and produce a self-contained converter device which can be connected between the previously incompatible devices.



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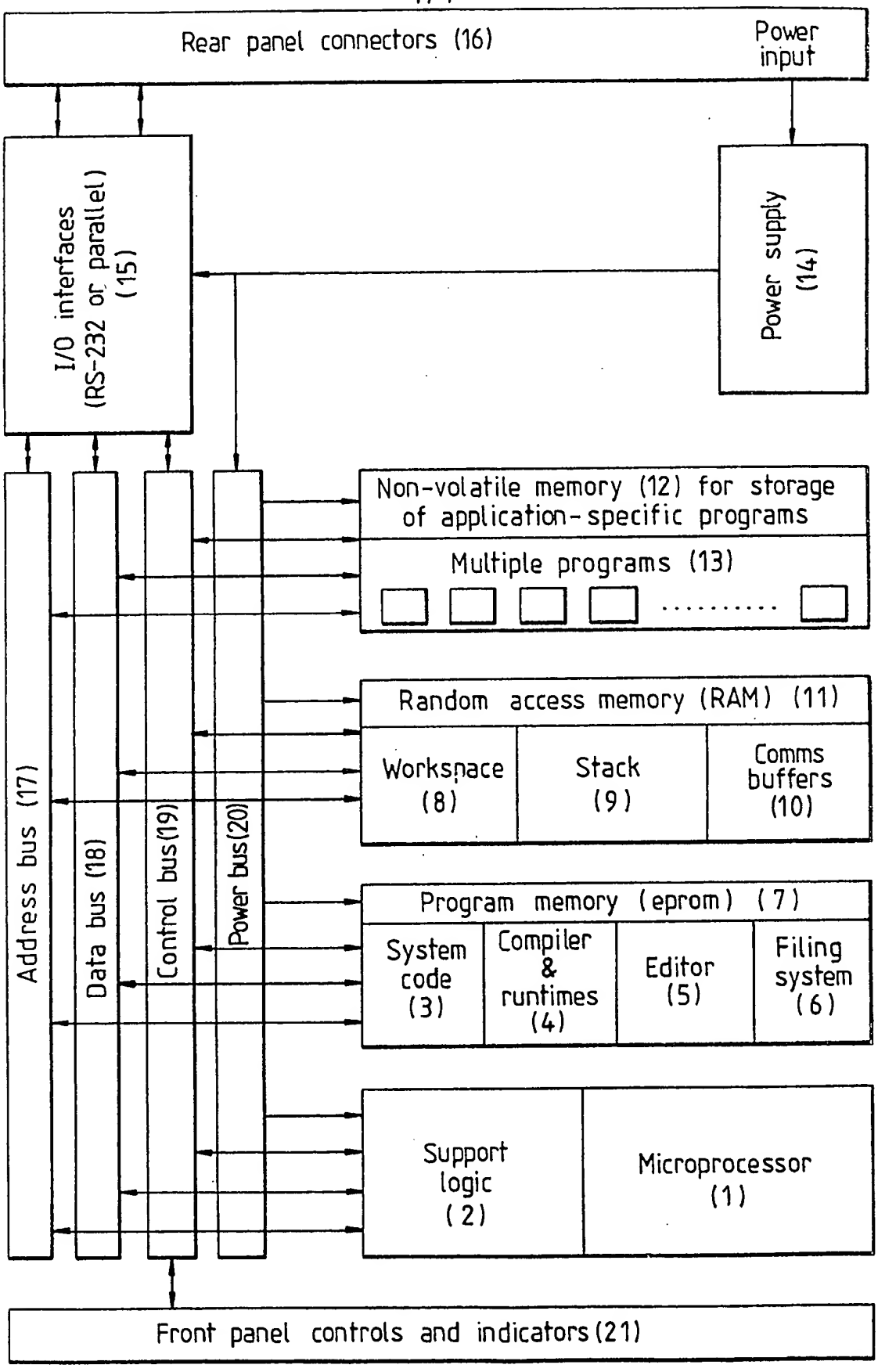
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.


Rear panel connectors (16)
Power input
I/O interfaces (RS-232 or parallel) (15)
Power supply (14)
Non-volatile memory (12) for storage of application-specific programs
Multiple programs (13)
Random access memory (RAM) (11)
Workspace (8)
Stack (9)
Comms buffers (10)
Program memory (eprom) (7)
System code (3)
Compiler & runtimes (4)
Editor (5)
Filing system (6)
Support logic (2)
Microprocessor (1)
Address bus (17)
Data bus (18)
Control bus (19)
Power bus (20)
Front panel controls and indicators (21)

"PROGRAMMABLE PROTOCOL CONVERTER"

The present invention relates to a programmable protocol converter (PPC) that is a device which can modify a data stream (such as an RS-232 data stream) by means of an internal high level language program which can be written by a person who is not an expert in the hardware and software details of a data communications device.

With the proliferation of computers and computer-based devices, there are many instances where the data stream emitted by one device is not compatible with the intended destination device, even when the interfaces of the interconnected devices are comparable electrically. In such cases the incompatibility is often simple and can be solved by a simple modification of the data.

However, the construction of a customised converter device which performs the required modification of the data is not a trivial task. It requires expertise in microprocessor hardware design, in low-level microprocessor software, and in fundamental principles of data communications as applied to microprocessor-based hardware. It requires an expenditure of time which is likely to be disproportionate relative to the value of the desired solution. The cost of the hardware for the device is also likely to be excessive given that only one or a small quantity may be required.

In the past, the requirement for such data conversion has been partly addressed by products known as single board computers.

These are microprocessor-based devices which may contain the basic hardware required to implement a data converter. The user of such a single board computer must usually write all the difficult software mentioned in the previous paragraph and while the hardware cost may be acceptable, the cost of the time will usually not be.

Another approach is to use a personal computer and program it to perform the required conversion. The disadvantage of this approach is the cost, the physical size and that the above-mentioned software expertise is still required of the user.

Any cost-effective solution to this data conversion requirement should include a versatile hardware product and an easy and quick method of writing a program to perform the desired data modification. The program should be in a high level language such as Basic or Pascal or C, and should execute sufficiently fast to make the converter suitable for the high data rates found in modern computer peripherals.

According to the present invention, there is a programmable protocol converter adapted to modify a data stream by means of an internal high level language programme, which can be written by the user, the converter comprising the combination of:- a microprocessor, a high level language compiler, and one or more software storage devices at least one of which is a non-volatile memory, and one or more interfaces.

Preferably the compiler is a Pascal compiler or a C compiler or both.

The converter may, optionally, include a basic interpreter and/or a programme editor.

Both the high level language compiler and the editor may be integrated into the converter such that only a simple ASCII VDU terminal is required to enter, edit, compile, and test a user's programme.

The converter may include system software which manages the editing, compilation, storage and execution of multiple user programmes. It may also include data analysis functions which facilitate diagnosis and definition of the incompatibility whose elimination is desired.

The converter will normally require interfaces which may be, for example, selected from:- RS-232, Centronics parallel, RS-422, and RS-485 and combinations thereof.

Optionally the converter is fitted with analogue input/output circuitry to permit the converter to act as an analogue data acquisition system or as an analogue function generator.

There may also be a facility which allows a user-specified programme to be automatically executed whenever the converter is powered up, even if the programme is stored within the converter

in source form only.

Preferably facilities are provided for encrypting a programme.

In its preferred form, the PPC contains everything needed to enable a user with limited expertise to write a data conversion program and to finish with a self-contained converter device which, once the conversion program is functioning, can be left in place connected between the previously incompatible devices.

The PPC may be used in a wide range of applications in addition to the above described data modification application: it can be programmed for an input-only application where it monitors a data stream for errors or other special conditions, or it can be programmed for an output-only application where it generates a user-modifiable data stream which can be used for testing or exercising other devices.

While it is envisaged that the PPC will initially be fitted with RS-232 interfaces because these are among the most common interfaces used in the field of computer peripherals, as mentioned above, other interfaces such as Centronics Parallel or RS-422 or RS-485 can be fitted. In all such applications, the user would greatly benefit from the ease of generating and modifying the high level language program controlling the PPC.

While a compiler (rather than an interpreter) will produce the fastest executing programs and also enable the writing of a more sophisticated program within the storage space limitations of the PPC, a simple Basic interpreter may also be provided which enables a user with very minimal programming expertise to generate a simple data conversion program. When the high level language compiler and the editor are integrated in the PPC, only a simple ASCII VDU terminal is required to enter, edit, compile and test the user's program. Alternatively, a computer may be used as the terminal by means of a terminal emulation program executing on that computer.

If, during the development of the user's data conversion program, the user may desire to separately write and test multiple programs, the PPC supports the creation, editing, storage and compilation of multiple high level language programs. Because in most applications only one program will ultimately be used even though multiple programs may be developed and stored in the PPC, a facility may be provided which allows a user-specified program to be automatically executed whenever the PPC is powered-up. If the user-specified program is stored in the PPC in high level language source form as originally created by the user, the program is automatically compiled prior to execution.

The optional functions for encrypting a high level language program are included for the following reasons. A high level language program if stored in the PPC in source form, would if not encrypted be readable by

anyone who connects a terminal to the PPC and enters the program edit mode. Further, if the program which has been selected for automatic execution at power-up is encrypted, it will be automatically decrypted during compilation in a temporary manner arranged to render it impossible to capture the unencrypted program text without the use of sophisticated equipment and expertise.

In the accompanying single sheet of drawings, one embodiment of the invention is illustrated by way of example.

The programmable protocol converter shown in the single figure of the drawings includes a number of features which, as is clear from the text above, are optional features. As seen in the drawing, the converter comprises a microprocessor 1 with support logic 2. The converter has a front panel with controls and indicators 21 which feeds into a control bus 19. Rear panel connectors 16 include a power input which feeds the power supply which in turn feeds a power bus 20. There is also a conventional data bus 18 and address bus 17. Interfaces 15 may be provided between the rear panel connector 16 and the various buses and interfaces may also be fed by the power supply 14.

A number of memories are provided. Firstly there is a non-volatile memory 12 for storage of application-specific programmes which may contain the multiple programmes 13. The non-volatile memory 12 is connected as can be seen to the four buses 17, 18, 19 and 20.

Secondly there is a random access memory 11 containing a work space 8, a stack 9 and comms buffers 10, again connected to the four buses. Thirdly there is a programme memory 7 (EPROM) which contains a system code 3, a compiler and run times section 4, an editor 5 and a filing system 6.

This completes the basic hardware and software necessary to build a preferred form of programmable protocol converter embodying the invention.

The basic essential features of this converter are the microprocessor 1, the high level language compiler 4 and one or more of the software storage devices 7, 11 and 12 together with one or more interfaces 15 which may in the present instance be, for example, RS-232 or Parallel interfaces.

The mode of usage of the PPC is as follows:
First, the user will indentify the problem to be solved, by examining any data flowing from one device to the other. The PPC has an Input Hex Dump function which non-intrusively receives and displays (in hex and ASCII) data flowing along a cable.

Second, the user will determine what modification to the data is required. This will become evident partly from the above and partly from consultation of the documentation of the devices involved.

Third, the user will write a programme in the PPC's high level language. This involves entering the PPC Editor and entering the programme text, followed by an invocation of the PPC compiler. If the compiler finds errors, the user returns to the Editor to correct those errors and then recompile. Optionally, the compiler could enter the Editor automatically on encountering an error and open the programme text for editing at the error location.

Fourth, the user will test the programme by connecting the PPC between the two devices whose compatibility is desired. An initial version of a programme could contain debugging statements which print to the PPC's terminal when a particular part of the programme has been executed.

CLAIMS

1. A programmable protocol converter adapted to modify a data stream by means of an internal high level language programme, which can be written by the user, the converter comprising the combination of:- a microprocessor, a high level language compiler, and one or more software storage devices at least one of which is a non-volatile memory, and one or more interfaces.

2. A converter according to claim 1 and in which the compiler is a Pascal compiler or a C compiler or both.

3. A converter according to claim 1 or claim 2 and including a Basic interpreter.

4. A converter according to any preceding claim and including a programme editor.

5. A converter according to claim 4 and in which both the high level language compiler and the editor are integrated into the converter such that only a simple ASCII VDU terminal is required to enter, edit, compile and test a user's programme.

6. A converter according to any of claims 1 to 5 and which includes system software which manages the editing, compilation, storage and execution of multiple user programmes.

7. A converter according to any preceding claim which also includes data analysis functions which facilitate diagnosis and definition of the incompatibility whose elimination is desired.

8. A converter according to any preceding claim and in which the converter is fitted with interfaces selected from:- RS-232, Centronics parallel, RS-422, and RS-485 and combinations thereof.

9. A converter according to any preceding claim which is fitted with analogue input/output circuitry to permit the converter to act as an analogue data acquisition system or as an analogue function generator.

10. A converter according to any preceding claim including a facility which allows a user-specified program to be automatically executed whenever the converter is powered-up, even if the program is stored within the converter in source form only.

11. A converter according to any preceding claim including facilities for encrypting a program.

12. A programmable protocol converter substantially as hereinbefore particularly described and as illustrated in the accompanying drawings.

Amendments to the claims have been filed as follows

1. A programmable protocol converter adapted to modify a data stream by means of an internal high level language programme, which can be written by the user, the converter comprising the combination of:- a microprocessor, a high level language compiler, and one or more software storage devices at least one of which is a non-volatile memory, and one or more interfaces, and including a Basic interpreter, and a programme editor, in which both the high level language compiler and the editor are integrated into the converter in such a manner that only a simple ASCII VDU terminal is required to enter, edit, compile and test a user's programme.

2. A converter according to Claim 1 and in which the compiler is a Pascal compiler or a C compiler or both.

3. A converter according to Claim 1 or Claim 2 and which includes system software which manages the editing, compilation, storage and execution of multiple user programmes.

4. A converter according to any preceding Claim which also includes data analysis functions which facilitate diagnosis and definition of the incompatibility whose elimination is desired.

5. A converter according to any preceding Claim and in which the converter is fitted with interfaces selected from:- RS-232, Centronics parallel, RS-422, and RS-485 and combinations thereof.

6. A converter according to any preceding Claim which is fitted with analogue input/output circuitry to permit the converter to act as an analogue data acquisition system or as an analogue function generator.

7. A converter according to any preceding Claim including a facility which allows a user-specified programme to be automatically executed whenever the converter is powered-up, even if the programme is stored within the converter in source form only.

8. A converter according to any preceding Claim including facilities for encrypting a programme.

9. A programmable protocol converter substantially as hereinbefore particularly described and as illustrated in the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

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Relevant Technical fields

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(ii) Int CL (Edition 5) G06F 13/38

Search Examiner
S J PROBERT

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
9 JUNE 1992

1-9

Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2241360 A (JUPITER TECHNOLOGY) see whole document	1-3,5,7
X	GB 1573046 (BUNKER RAMO) see whole document	1 at least
X	EP 0391157 A2 (SIEMENS) see abstract	1 at least
X	EP 0288713 A2 (IBM) see abstract	1 at least
X	EP 0259786 A1 (XMIT AG) see abstract	1 at least
X	EP 0193139 A2 (I.S.E.C) see particularly page 3 lines 2-9	1 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

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